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## Supplier selection and evaluation using Alteryx tool AHP in gear manufacturing industry

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**Abstract:** One of the most important problems for many firms is the decision-making process in supplier selection. The most inclusive process in the decision-making process is the analytical hierarchy process. This study gives instructions for setting supplier selection criteria for university procurement department purchasing activities. The decision-making method of the AHP is based on a multi-criteria examination of cost, flexibility, quality, delivery, and polish or machining property. This work provides clarity in the classification of supplier attributes that have been emphasised in the model business. It gives an idea about the AHP and also how to select the supplier using with necessary criteria. The data collection is done in the gear manufacturing industry. A total of 20 suppliers were considered for our evaluation. Out of 20 suppliers, three suppliers got the highest priority rank of 96.9% among all suppliers by considering various factors such as price, quality, on-time delivery, etc.

**Keywords:** supplier selection and evaluation; supplier ranking; analytic hierarchy process; AHP; Alteryx tool.

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## 1 Introduction

The analytic hierarchy process (AHP) is a decision-making aid that can be used to solve difficult decisions in multi-criteria decision-making. Objectives, criteria, sub-criteria, and options are organised in a multi-level hierarchical structure in the AHP tool. A collection of pairwise comparisons is used to extract the relevant data. These comparisons are used to determine the choice criteria's weight of importance, as well as the relative performance measure of the alternatives in terms of each particular decision criterion. It gives a way for enhancing consistency if the comparisons are not entirely consistent.

The AHP has been used in industrial engineering problems such as integrated manufacturing, technology investment decision evaluation, flexible manufacturing systems, layout design, and other engineering problems.

The goal of this article was to look into how manufacturing strategies may influence business enterprises' supplier selection criteria. To emphatically understand the research argument, a design/methodology/approach survey strategy was adopted. The underlying structure of the supplier selection criteria was first validated using principal component factor analysis. The study hypotheses were then tested using simple regression analysis.

### 1.1 Alteryx tool

Alteryx is a data analytics tool used to create insights from the raw data. Which is mainly used for cleaning the data file, modifying the data, and manipulating the data. Alteryx has different types of tools in this tool. For example, join tool, filter tool, sort tool, input tool, output tool, etc. Alteryx is a drag-and-drop mechanism to analyse data. There are many tools in the tool palette and simply drag a tool and drop it into a workspace canvas for making workflow. Each tool is an input and output node for analysis of the data table. All tools are connected by the nodes and each tool has different functionality. Once you create a workflow with a tool we can easily run the workflow to get an output. There are three windows in the Alteryx tool. The first window is the workflow canvas second window is the configuration window and the last window is the result window.

In this study, we gathered both qualitative and quantitative data. On-site interviews and surveys, as well as observational notes and concentrated group discussions, are all major data sources the work is carried out in the gear manufacturing industry located at Coimbatore, and 20 suppliers are considered for evaluation purposes. The data collection, methodology, and result are discussed in the below section.

## 2 Literature review

Purchasing and procurement are critical functions in any organisation. Supplier selection and order allocation (SSOA) are key components of procurement and sourcing. Both qualitative and numerical factors including such quality, cost, and delivery time should be considered. Be taken into account in the problem of choosing suppliers. As a result, supply chain strategy is a multi-criteria process. Multi-criteria decision-making (MCDM) issue addressed by Cheraghalipour and Farsad (2018) in supply selection and evaluation process. The main selection criteria was price, timely deliver the product, non-defective product and assurance. The MCDM tool applied for finding right supplier for the organization for decision-making process.

Using appropriate supplier selection methods can save money and reduce risks. Some researchers have merged supplier preference and order distribution to solve both problems at the same time (e.g., Babbar and Amin, 2018). In terms of sustainability and environmental factors, supplier preference and order allocation are critical in green supply chain management. Sustainable supplier selection considers cost, environmental, and social factors, as well as the performance history of the supplier.

Procurement process is a systematic procedure in organisations that is critical to their success. Offering quantity discounts is an important consideration when choosing the best suppliers. As a result, each company can achieve low costs while allocating high volume orders to vendors (Alegoz and Yapicioglu, 2019).

Simi et al. (2017) examined articles in supplier selection and evaluation that are based on fuzzy sets theory, fuzzy models, and fuzzy hybridisation over the last 50 years (50th anniversary of fuzzy sets theory created by Lotfiali Askar Zadeh in 1965). To successfully review the fuzzy vendor selection methods, the researchers compared individual and integrated approaches. The authors chose 54 papers from peer-reviewed journals.

A popular method in this field is fuzzy multiple-objective programming. Furthermore, Ahmadi and Amin (2019) used a genetic algorithm to determine the orders. Most of the researchers conducted a review of SSOA papers published between 2013 and 2018 and suggested the parameter for selecting the supplier includes on time delivery, commitment towards providing quality of the product and product reasonable cost. They discovered that the most popular techniques for SSOA are MCDM methods and optimisation.

Babbar and Amin (2018) discussed one of the most significant responsibilities done by a purchasing department has historically been the identification of component suppliers for products and services. The modern business environment is characterised by competition not only between enterprises, but also between supply networks. For products and services, businesses rely largely on suppliers. An expanded supply chain emphasises the need of having a successful supplier selection process, given the increased reliance on suppliers and the increasing complexity of products and services.

Kumar et al. (2017) described to acquire intelligence about possible suppliers and pick the best providers; an effective supplier selection process is required. A successful supplier selection process is critical when forming partnerships with suppliers and sustaining relationships with them. A good supplier selection process can assist an organisation improve process capability, delivery timelines, remove unnecessary expenses, and increase overall efficiency. Torabi et al. (2015) highlighted the key points in organisations first assess the market situation before developing supplier selection criteria and recommendations. Finally, the organisation and the supplier sign a formal

supply chain cooperation agreement to create a working relationship. Feedback to the open market can be used to communicate supplier evaluation and selection information.

Beauchamp et al. (2015) developed companies with a competitive supplier base can benefit from long-term supplier relationships. Companies that establish a mechanism for long-term supplier relationship management can improve performance by monitoring the end-to-end procurement process and ensuring cost, quality, delivery, and time competitiveness. The argument was that a process model should be well specified, and that transaction efficiency in the process can be achieved by using the right communication tools.

Aggarwal et al. (2018) discussed supplier relationship management strategy. He claims that two aspects of it are imparted, namely supplier connectedness and their alignment with the company's goal. These two characteristics are crucial in e-procurement because they can help employees choose a supplier and minimise the cost of sending purchase orders and other messages to and from suppliers. Scott et al. (2015) introduced a decision support system for supplier selection and evaluation in multi criteria decision making with multi stakeholder.

Cheraghalipour and Farsad (2018) with the growing relevance of outsourcing and supplier selection functions, the purchasing function has become a vital supply chain management component to ensure successful supplier selection decisions and execution to give the company a competitive advantage in the supply chain. Organisations that execute improvement initiatives to improve flow and eliminate variances in their processes will stabilise the process.

Yildiz and Yayla (2015) are seemed supplier evaluation and selection by using the AHP approach. The reference provides a straightforward approach to evaluate each criterion based on its importance. A multi-criteria selection process can help you save time and effort while looking for a supplier. Mohammaditabar and Ghodsypour (2016) developed the decision model is used for supplier evaluation and selection proposed AHP model based on supplier performance scoring selecting the best supplier could deliver the proper quantity, at the right price, and on time.

Prasanna Venkatesan and Goh (2016) developed a supplier selection project using an integrated Delphi, AHP and Taguchi loss function. To value and select suppliers, this article uses an integrated modified Delphi technique, AHP, and Taguchi loss functions systems. The benefits of these strategies are well known: increased adoption of critical performance criteria in suppliers and enhanced decision-making efficiency. To begin, the criteria were obtained using the Delphi technique, which included product quality.

Alegoz and Yapicioglu (2019) formed lean supplier selection: a data envelopment analysis (DEA). The primary goal of this research is to develop an integrated model for evaluating suppliers from a lean manufacturing standpoint. Although lean manufacturing has received a lot of attention in the past, its integration with supplier selection has received less attention. This study was intended to fill this gap by methodically proposing an integrated methodology to selecting suppliers based on lean related factors.

Alkahtani and Kaid (2018) developed new approach for supplier selection and evaluation, reviewed more than 40 articles in supplier selection management. This article suggested the quality, cost, committed deliveries are key in supplier selection criteria.

### **3 Problem description**

The company has faced buying raw materials that as steel among different suppliers. The raw material greatly affects the end product gear in many aspects. This affects the company's profit and degrades the value of the company to the customer. We have given a solution for that by ranking the suppliers based on the requirement on the priority level provided by the company. We have arranged the supplier from best to worst ranked based upon the requirements. By this, we full fill the company's needs and solve the problem of selecting a suitable supplier.

### **4 Criteria for supplier selection**

Criteria for supplier selection are the most important. Weightage has to be allocated based on its success. This weightage data is collected from the supplier handling manager. The supplier manager makes the criteria have to be evaluated according to user demand. Here according to the criteria, we have taken the case are cost, quality polish, and time of delivery in the number of days. Some other criteria are also there, but they can be neglected. So we include the four main criteria for the supplier selection. The four criteria are given different weightage based on their usage.

#### *4.1 Cost*

The first criterion comes is the cost of the material, different suppliers provide material at different costs. The weightage in cost has to be mentioned we should not compromise with the cost. Because it directly affects the final price of the product if we buy material from higher price supplier. The company may get loss financially so we have to manage cost and quality equally which should not affect the final product price and quality. The most confusing of the supplier selection is the cost time the cost is high despite the quality being low and delivery being good at the time the making of the decision is more complex to identify the good supplier so we choose one of the criteria.

#### *4.2 Quality*

The primary criterion is quality if the quality is affected the entire product may be glossed and also there will be a loss of greater material polishing or manufacturing process. The quality of the material should not be compromised while allocating the criteria. Because most the supplier has a problem supplying quality material. The selection of suppliers without considering the quality may cause loss. So the quality has to give higher weightage according to the user case.

#### *4.3 Polish*

The Polish here refers that some suppliers may the material without surface finishing. This cause some loss in a material due to surface finish some material may get loss so selecting a supplier who gives a good finished of surface material is very important. If the material is not very polished on its surface there may be some material loss due to further

process of any material get wasted to avoid these ways we have to select a supplier who gives polished material.

#### 4.4 Delivery

In selecting the supplier the delivery is very important because if the delivery time is getting increased there may be a material shortage this shortage may affect the product delivery time the delivery has to be minimum as much as possible because of how the delivery time.

Table 1 shows the rating of the supplier during data collection from the industry

**Table 1** Scale of relative importance

<i>Importance value</i>	<i>Meaning</i>	<i>Explanation</i>
1	Equal importance	Both actions contribute equally to the goal's achievement.
3	Low significant	Experience and judgement prefer one activity over another by a smidgeon.
5	High importance	One activity is strongly flavoured over another by experience and judgement.
7	Very high significance	An activity is greatly favoured, with evidence of its dominance in practice.
9	Absolute significance	The evidence that favour's one action over another is of the greatest possible quality.
2, 4, 6, 8	Between the two neighbouring judgements, there are some values that are in the middle.	When you need to make a compromise
Above non-zero reciprocity	When comparing activity I to activity j, if activity I has one of the above nonzero integers given to it.	No priority given to the evaluation of the supplier

## 5 Data collection

The weighted point models are written in below equation (1):

$$S_j = \sum_i^n w_i p_{ij} \quad (1)$$

where  $S_i$  is the entire expected performance from vendor  $j$ ;  $w_i$  denotes the importance weight assigned to evaluate criteria  $p_{ij}$  denotes the performance rating on evaluative criteria if for supplier  $j$  and  $n$  is the number of evaluative criteria. To apply the aforementioned methodology, the supplier evaluation criteria must first be identified and a weight point applied. The connected purchasing personnel will then appraise the supplier's performance based on their gut instinct. Thompson pointed out that the

weighted point choice is based on mathematics. Weighted point models, on the other hand, have several drawbacks. The rating of the supplier listed in Table 2 and considered for further evaluation.

**Table 2** The rating of the supplier

<i>Supplier</i>	<i>Price</i> (per kg in Rs)	<i>Quality</i> (rating out of 5)	<i>Polish</i> (rating out of 5)	<i>Delivery</i> (in days)
Supplier 1	240	4	2	3
Supplier 2	210	3.9	4	4
Supplier 3	235	3.5	5	3
Supplier 4	200	4	2	4
Supplier 5	160	3	1	7
Supplier 6	180	4	3	5
Supplier 7	190	4.5	3	6
Supplier 8	194	3.5	4	8
Supplier 9	215	3.3	3	4
Supplier 10	180	4	5	7
Supplier 11	220	3.5	4	4
Supplier 12	190	3.6	3	5
Supplier 13	215	3.7	4	4
Supplier 14	200	3.7	4	4
Supplier 15	205	4	3	4
Supplier 16	234	3.9	3.5	3
Supplier 17	211	3.5	4.2	3
Supplier 18	221	3.8	4	4
Supplier 19	195	3.6	3.8	5
Supplier 20	186	3	3.5	6

### 5.1 Pair wise comparison matrix

Table 3 describes the uses of the criteria like price, quality, polish, and delivery that are compared and the criteria points that are concerning their given criteria because it is fully based on the decision-making process. In this table, the scale level 1 is of equal importance because it was equal concerning their same criteria.

**Table 3** Pair wise comparison matrix

<i>Criteria</i>	<i>Price</i>	<i>Quality</i>	<i>Polish</i>	<i>Delivery</i>
Price	1.00	1/7	1/5	1/3
Quality	7.00	1.00	2.00	3.00
Polish	5.00	1/2	1.00	3.00
Delivery	3.00	1/3	1/3	1.00

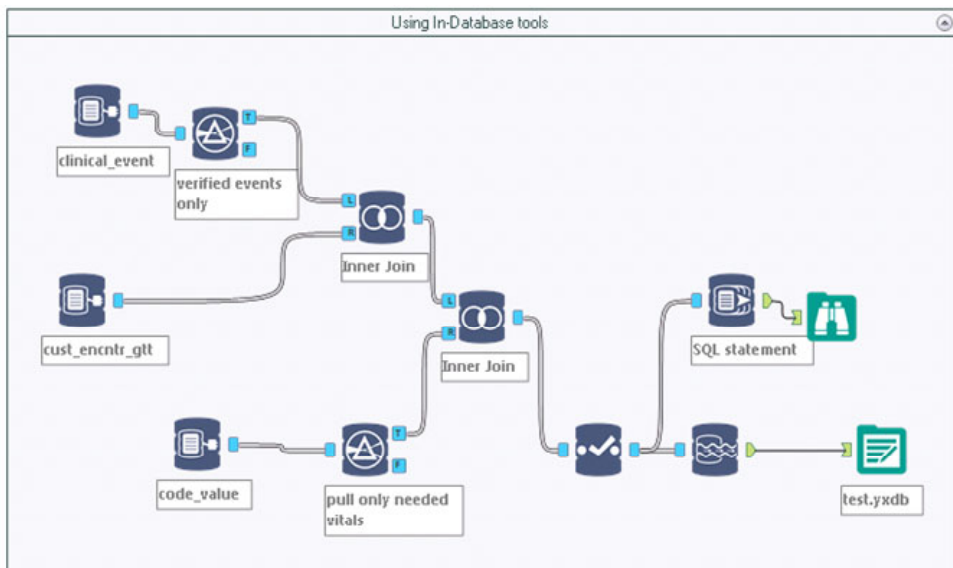


Often, qualitative data cannot be expressed in absolute terms. Although knowledge concerning questions like the one above is critical in making the right decision, quantifying them effectively is challenging, if not impossible. As a result, many decision-making methods seek to evaluate the relative importance or weight of the alternatives in terms of each of the criteria in a given decision-making situation.

### 5.2 Work flow for criteria weightage

This is the workflow in Figure 1 to find the criteria weightage and check the sum value of criteria weightage. There are many tools connected to finding the criteria. All tools are joined by the nodes of the input and output nodes. Important tools used in this workflow are summarise, union, formula, multirow formula, and text report. Each tool contains different logic and condition to do some operations. The output of one tool act as the input of another tool. The formula tool has the configuration window for entering the formula. Summarise tool has the function of sum; count, group by, and more aggregation functions for numerical and string values.

**Figure 1** Work flow for criteria weightage in Alteryx tool (see online version for colours)



### 5.3 Workflow for weighted sum value

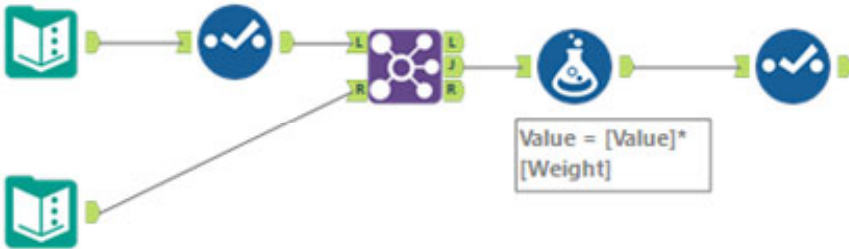
Two workflows are joined together to calculate finding weighted sum value for checking the process whether correct or not. There are many tools are used join tool, formula tool, summarise tool union tool multi-row formula, count records, select tool and browse tool, etc.

The join tool is very useful to join the table based on both position and the same field name and we can also add more fields and remove fields also available. There are three output nodes are in that join tool. The formula tool is used to make any calculation in the table. It can be applied for both columns and row-wise.

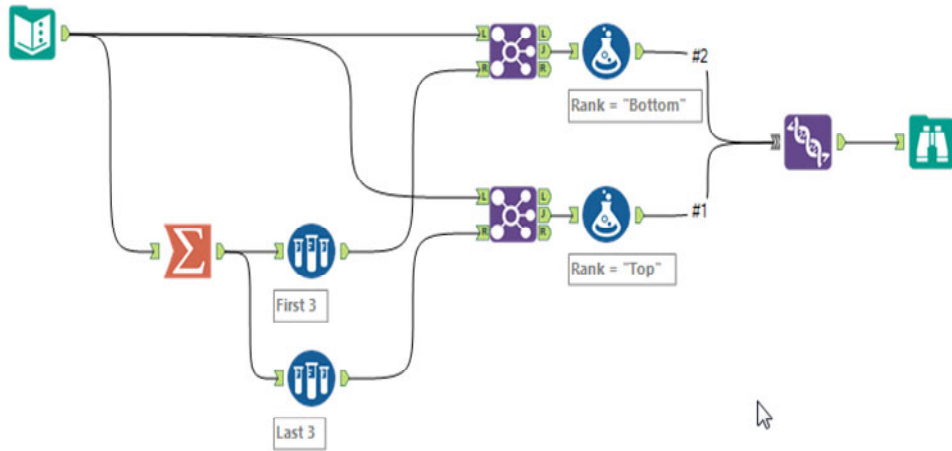
5.4 Workflow for finding rank and charts

This workflow is created in Figure 3 for finding results and finding the appropriate supplier among all suppliers. It also includes interactive charts of the suppliers by overall criteria and suppliers. This is an advanced model to find the appropriate supplier from many suppliers.

**Figure 2** Workflow for weighted sum value (see online version for colours)



**Figure 3** Workflow for finding rank and chart (see online version for colours)



The important tool used in this workflow reporting chart, table chart, multirow formula, and browse tool. The reporting tool consists of charts like a bar chart, pie chart, line chart, area chart, etc. The table chart is used to make the report for making integration.

The browse tool is used to report charts, tables, or preview the data and also we can use it for profiling data like sum values and null values. The transpose tool is used to transform the data from vertical to horizontal.

6 Result and discussion

Table 4 describes the overall priority of suppliers and rank

Supplier 3 has the highest priority. This way we can create insights from the table. Supplier 5 has the least priority so we can avoid buying raw materials among that all suppliers. From the result the supplier selection by the rank given in the supplier selection by the rank table. This table shows that each supplier had a rank by the supplier's criteria are price, quality, polish of the material, and delivery time depending on the rank of the supplier. The ranks are provided to all suppliers by the overall priority and rank is given to the supplier. There are many functions used to make easy the process of creating a model or algorithm to process the data.

**Table 4** Ranking matrix of the supplier

<i>Suppliers</i>	<i>Overall priority</i>	<i>Rank</i>
Supplier 3	96.9	1
Supplier16	87.6	2
Supplier17	87.6	3
Supplier 2	87.4	4
Supplier18	86	5
Supplier14	85.3	6
Supplier 7	85.2	7
Supplier13	84.9	8
Supplier15	82.5	9
Supplier11	82.4	10
Supplier 6	80.9	11
Supplier19	80.7	12
Supplier 1	79.4	13
Supplier 10	78.8	14
Supplier 8	77.4	15
Supplier 4	76.5	16
Supplier12	75.9	17
Supplier 9	73.9	18
Supplier20	70.4	19
Supplier 5	54.6	20

The AHP is used to find an appropriate supplier based on the above mathematical calculation. We should find the top supplier based on the rank given in the above supplier selection by the rank table. Supplier 3 is ranked first in this table, indicating that it has a high priority to purchase a large quantity of raw material. Because supplier 3 is superior to the other suppliers in terms of the given criteria of cost, quality, polish, and delivery.

Suppliers 16 and 17 are the second and third most useful suppliers in the supplier table if we go with this suppliers 16 and supplier 17 are the most useful supplier for making the production more effective in terms of quality and cost.

## 7 Conclusions

Many researchers and practitioners have concentrated their efforts on supplier selection in the supply chain management field, employing a wide range of scientific and technical techniques to improve the supply network's efficiency and adaptability. Various ways for supplier selection are available.

As a result of the foregoing insights, MCDM approaches should be employed as decision support tools rather than as a means of determining the ultimate answer. The solution's conclusion should be regarded lightly and used just as a guide to what might be the best solution. Even though the hunt for the optimum MCDM approach may never be complete, research in this area of decision-making remains vital and valuable in a variety of scientific and technical applications.

From the above calculation, the AHP is used to find an appropriate supplier by the above mathematical calculation. From the above supplier selection by the rank table, we should find the top supplier according to the rank given. In this table supplier, three are in rank 1, so supplier 3 is a high priority to purchase the high quantity of raw material. Because supplier 3 is good to compare to the other supplier concerning the given criteria are cost, quality, polish, and delivery.

In the supplier table supplier, 16 and supplier 17 are the second and third place if we go with this supplier 16 and supplier 17 are another most useful suppliers for making the production more effective with the quality and cost base.

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